



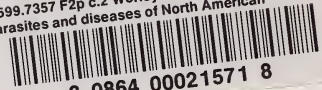
Parasites and Diseases of North American Elk (*Cervus* spp.)

—ANNOTATED BIBLIOGRAPHY—

Montana Department of Fish and Game
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PARASITES AND DISEASES

of

NORTH AMERICAN ELK (CERVUS SPP.)

— AN ANNOTATED BIBLIOGRAPHY —

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Photographs by Donald H. Fritts

INTRODUCTION

This report originally was conceived as an outgrowth of the Bibliography on Wapiti and Red Deer which was issued as Special Report No. 2 by the Montana Department of Fish and Game in 1968. As a general reference dealing primarily with life histories, food habits, distribution, and ecology, no attempt was made in the original publication to concentrate on factors affecting the health of elk populations. By limiting the scope of the current report to disease agents and other conditions affecting the well-being of elk, it is hoped that this bibliography will serve as a basic reference for biologists, veterinarians, and research workers specializing in the study of wildlife diseases. Citations are limited primarily to literature on the Rocky Mountain elk (*Cervus canadensis nelsoni*), Roosevelt elk (*Cervus canadensis roosevelti*), and Tule elk (*Cervus elaphus nannodes*). A few references on the Altai Wapiti (*Cervus canadensis asiaticus*) are included because of possible similarities in the parasite fauna of the Asian and North American subspecies. Work published through 1975 has been listed.

References are arranged alphabetically according to the last name of the senior author. To locate an abstract on a particular disease or etiologic agent, consult the subject index on page 46, which is subdivided into six major categories: parasitic, bacterial, rickettsial, viral and fungal infection, and a separate heading covering deficiency diseases, anomalies, and other noninfectious disorders. The numbers listed for each category refer to specific abstracts identified with the corresponding number under the author's name in the text. References dealing with more than one subject thus appear several times in the subject index. Attempts have been made to use common names of diseases or abnormalities wherever the meaning was clear. In a few instances, both common and scientific names have been used to avoid confusion. Because of the broad scope of the bibliography, many references do not deal with pathologic conditions *per se*. Our approach has been to list publications which refer either to naturally occurring or experimentally induced conditions which have the potential to influence the health of a free-ranging or confined elk.

Because of the sources of information used for this index are so diverse, no attempt was made to list all of the abstracting journals and references consulted. Among the most useful bibliographic sources were Helminthological Abstracts, Veterinary Bulletin, Index-Catalogue of Medical and Veterinary Zoology, Wildlife Review, Index Veterinarius, Biological Abstracts, and Zoological Record. A previous bibliography on Diseases of Cervidae which was edited by Dr. Lars Karstad and published in a microcard and microfiche edition by Wildlife Disease in 1964 and 1969 was used extensively to obtain annotations and verify citations. The Conservation Library Center of the Denver Public Library furnished unpublished information on elk diseases which has appeared in Federal Aid Reports.

Adcock, J. L., and C. P. Hibler

- 1 1969 Vascular and neuro-ophthalmic pathology of elaeophorosis in elk. *Pathol. Vet.* 6:185-213.

Elaeophora schneideri was identified as the cause of a specific neuro-ophthalmic disorder of elk (*Cervus canadensis*) in Arizona, Colorado, New Mexico and Wyoming. This intra-arterial nematode was found within the cephalic arterial system in 10 of 16 elk with visual disturbances. Pathologic findings indicated that the parasite and the vascular lesions which it caused resulted in impairment of cephalic arterial circulation. Blindness and death were attributed to ischemic damage in the brain, eyes and optic nerves. Although *E. schneideri* is a relatively common parasite of deer and domestic sheep in certain mountainous regions of the western and southwestern United States, it had not been reported in elk prior to this study.

Adcock, J. L., C. P. Hibler, Y. Z. Abdelbaki, and R. W. Davis

- 2 1965 Elaeophoriasis in elk (*Cervus canadensis*). *Bull. Wildl. Dis. Assoc.* 1(4):48.

Blindness observed in elk over a period of 2 decades by Arizona Fish and Game Dept. is a result of lesions within the eyes, optic nerves, brains or a combination thereof and has been found due to *Elaeophora schneideri*.

Adcock, J. L. and R. E. Keiss

- 3 1969 Locoism in elk. A disease resembling cerebral pseudolipidosis. *Bull. Wildl. Dis. Assoc.* 5:121-124.

Spontaneous locoism due to ingestion of *Astragalus* and *Oxytropis* was observed over a three-year period in wild elk in a mountainous region southwest of Denver, Colo. Occurrence of the disease was limited to the months of March through August of 1966-69. Incidence of the disease was unknown, but as many as 35 dead elk were found in 1967. Clinical signs included emaciation, weakness and depression, muscular tremors, incoordination and posterior ataxia. Histopathological changes in the central nervous system included swelling and fine vacuolation of neurons and axonal dystrophy. Similar changes were observed in an elk fed pelleted locoweed.

Alderson, L. E.

- 4 1951 Internal parasites of the elk in Wyoming. *Univ. Wyom. Publ.* 16(4):77-78.

Alderson investigated the endoparasites of *Cervus canadensis nelsoni* in Wyoming and attempted to correlate the degree of parasitism with the concentration of the elk on winter feeding grounds. The comparatively low incidence in 1948-

1949 is attributed to the fact that the elk had not been aggregated in large numbers on this ground during the two preceding winters. The helminths recorded for the first time in this host in Wyoming were *Orthostromylus macrotis*, *Trichuris ovis*, *Capillaria brevipes*, *Ostertagia circumcincta*, *Nematodirus filicollis* and *N. spathiger*, of which the three last named are known to cause serious damage in domestic animals. *Dictyocaulus hadweni* and *Thysanosoma actinioides* were also present.

Allen, R. W.

- 5 1973 The biology of *Thysanosoma actinioides* (Cestoda: Anoplocephalidae) a parasite of domestic and wild ruminants. New Mexico Agri. Exp. Sta. Bull. 604. 68 pp.

Contains a summary of existing records of fringed tapeworms in elk in Alberta, British Columbia, New Mexico, South Dakota, Yellowstone National Park, Utah and Wyoming. On the basis of prevalence data, elk are considered to be a very suitable host for *T. actinioides*.

Allred, W.

- 6 1947 Bang's disease testing in elk. Wyoming Game and Fish Comm., Quart. Rept. W-13-R:11-12.

A serological survey of 65 Wyoming elk revealed a total of 6 reactors (9.2%).

Allred, W. J., R. C. Brown and O. J. Murie

- 7 1944 Disease kills feedground elk: necrotic stomatitis takes toll of Jackson herd. Wyoming Wild Life 9(2):1-8, 27.

Necrotic stomatis caused a mortality rate estimated at 10% in the Jackson Hole elk herd during the winter of 1942-43. Approximately 1,046 animals died, principally from *Actinomyces necrophorus* infections.

Anderson, C. C.

- 8 1958 The elk of Jackson Hole. A review of Jackson Hole elk studies. Wyoming Game and Fish Comm. Bull. No. 10. 184 pp.

Includes a section on mortality which considers the importance of weather and necrotic stomatitis to herd losses. *Dermacentor albipictus* and *Psoroptes equi* var. *cervinae* are briefly discussed.

Anderson, R. C.

- 9 1972 The ecological relationships of meningeal worm and native cervids in North America. J. Wildl. Dis. 8:304-310.

Introduction of elk into areas in central and eastern North America where they are associated with white-tailed deer has resulted in elk infections with meningeal worms (*Par-elaphostrongylus tenuis*).

Anderson, R. C., M. W. Lankester and U. R. Strelive

- 10 1966 Further experimental studies of *Pneumostrongylus tenuis* in cervids. *Can. J. Zool.* 44(5):851-861.

Two young wapiti (*Cervus canadensis nelsoni*) and a female mule deer fawn (*Odocoileus hemionus hemionus*) were infected experimentally with *Pneumostrongylus tenuis* from white-tailed deer (*Odocoileus virginianus borealis*). The male wapiti showed only slight clinical signs after infection, and first-stage larvae appeared in its faeces 92 days later. The female wapiti showed severe neurologic signs that terminated in general paralysis on the 54th day. The mule deer showed severe neurologic signs and died of paralysis on the 62nd day. Numerous worms were found in the subdural space and neural parenchyma, especially in the dorsal horns of grey matter, of the female wapiti and the mule deer. Traumatic damage in the dorsal horns was extensive, especially in the wapiti. Histopathologic findings were similar to those reported earlier in moose calves (*Alces americana americana*) infected with *P. tenuis*. Study of worms recovered from experimentally infected cervids indicates that *P. tenuis* develops similarly in white-tailed deer, moose, wapiti, and mule deer, although in the first species it causes little damage to the central nervous system. The possibility that *P. tenuis* could become established in wapiti introduced into eastern North America is noted.

Andrews, J. R. H.

- 11 1973 A host-parasite checklist of helminths of wild ruminants in New Zealand. *New Zeal. Vet. J.* 21:43-47.

Reports *Spiculopteragia asymmetrica* in wapiti for the first time.

Anonymous

- 12 1966 *Parasites and diseases of Cervidae*. *Can. Wildl. Serv. Queen's Printer, Ottawa.*

Only 1 of 594 elk sera was positive for *Brucella agglutinins*. There was one suspect leptospirosis agglutinins reaction among 331 elk sera.

Banfield, A. W. F.

- 13 1949 An irruption of elk in Riding Mountain National Park, Manitoba. *J. Wildl. Mgmt.* 13(1):127-134.

The elk herd harbored a heavy infestation of winter tick (*Dermacentor albipictus*). The majority of carcasses showed moderate to heavy infestation. An adult female elk examined post-mortem had a heavy infestation of biting lice (probably *Bovicola equi*). Of 2 elk necropsied, a heavy infection with *Dictyocaulus viviparus* was found.

Banks, N.

- 14 1908 A revision of the Ixodoidea, or ticks of the United States, Bull. Tech. Serv. (15), Bureau Entom. U.S. Dept. Agric. 61 pp.

Dermacentor albipictus were found on wapiti over a wide area.

Barrett, R. E. and D. E. Worley

- 15 1966 The incidence of *Dictyocaulus* sp. in three populations of elk in south-central Montana. Bull. Wildl. Dis. Assoc. 2(1):5-6.

Dictyocaulus sp. was present in two of three populations of elk examined, with 15.8% and 8.7% of the animals infected. One *Protostrongylus* was found in one elk, another was infected with *Thysanosoma actinioides* and 4 elk had *Cephenomyia jellisoni*.

Bassi, R.

- 16 1893 Il *Distomum magnum* (Bassi) in Italia ed in America. Mod. Zoolatro 4(14):269-270.

The giant liver fluke (*Fascioloides magna*, syn. *Distomum magnum*) is reported from elk introduced into Italy from the U.S. The original infections were found in *Cervus canadensis* and other cervids with which they were associated in a park in the Pisa area. The gross pathology of the infection is described in *Cervus moluccensis*, and the probable sequence of events leading to the transmission of the parasite to horses and other domestic animals in Italy is outlined.

Bau, A.

- 17 1906 Diptera. Family Muscaridae, subfamily Oestrinae. In Genera Insectorium (Wysman) fasc. 43. 31 pp.

Genus *Cephenomyia*, including 7 species on p. 17; Cervidae listed as larval hosts for the following genera: *Pharyngomyia*, *Cephenomyia*, *Hypoderma*, *Oedemagena*, *Dermatobia*. Includes keys to genera of adults and larva III. pp. 4-7.

Becker, E. R.

- 18 1950 Catalogue of Eimeriidae in genera occurring in vertebrates and not requiring intermediate hosts. Iowa State Coll. J. Sci. 31:85-139.

Lists three species of coccidia as occurring in elk: *Eimeria hegneri*, *Eimeria wapiti* and *Eimeria zurnii*. Includes measurements of the oocysts and key bibliographic citations for each species.

Bennett, G. F. and C. W. Sabrosky

- 19 1962 The nearctic species of the genus *Cephenemyia* (Diptera, Oestridae). Can. J. Zool. 40(3):431-448.

Cephenemyia jellisoni in *Cervus canadensis*, p. 431.

Bequaert, J. C.

- 20 1942 A monograph of the Melophaginae, or ked-flies, of sheep, goats, deer and antelopes (Diptera, Hippoboscidae). Entomol. Am. n.s. 22(1):1-210.

Lipoptena depressa and *Lipoptena cervi* recorded for *Cervus canadensis*. *L. depressa* is a characteristic parasite of *Odocoileus* and is probably a straggler on elk. *L. cervi* is a parasite of *Cervus elaphus* in Europe and is well established on *Odocoileus virginianus* in eastern U.S. It may spread to *Cervus canadensis* in North America as suggested by the single record.

Bequaert, J. C.

- 21 1946 The ticks or Ixodoidea of the northeastern United States and eastern Canada. Entomol. Am. n.s. 25:73-232.

A comprehensive and authoritative treatise of the subject. In the table on pages 127-128, *Dermacentor erraticus* var. *albipictus* is listed as a parasite of *Cervus canadensis canadensis* (Erxleben).

Bequaert, J. C.

- 22 1953 The Hippoboscidae or louse-flies (Diptera) of mammals and birds. Part I. Structure, physiology and natural history. Entomol. Am. n.s. 32:1-209 and n.s. 33:211-442.

The single or few records of keds or louse-flies from *Cervus canadensis* are thought to be strays from deer. No characteristic louse fly is known from American elk. The European elk, *Cervus elaphus*, is commonly parasitized by *Lipoptena cervi*. *L. cervi* has been introduced into North America and appears well established on deer, *Odocoileus virginianus*, and has been recorded at least once from the American elk by Bequaert, 1942.

Bequaert, J. C.

- 23 1954-57 The Hippoboscidae or louse-flies (Diptera) of mammals and birds. Part II. Taxonomy evolution and revision of American genera and species. Entomol. Am. n.s. 34:1-232; n.s. 35:233-416; and n.s. 36:417-611.

A review including keys to the genera (pp. 19-25) and to the species of *Lipoptena* (pp. 487-488), comments on the cervid forms on pages 483-507, and a host list (pp. 559-560).

Bergstrom, R. C.

- 24 1968 Parasites of ungulates in the Jackson Hole area. In Report on the activities of the Jackson Hole Biological Research Station, University of Wyoming, Summer, 1968, p. 4.

Feces from 60 elk were examined in spring, 1968 and from 86

elk in summer, 1968. Prevalence of internal parasites was as follows in spring and summer samples, respectively: *Marshallagia marshalli*, 2%, 0%; *Cooperia* sp., 18%, 0%; *Trichostrongylus* sp., 3%, 0%; *Nematodirus* sp. 0%, 11%; *Moniezia* sp., 8%, 11%; *Dictyocaulus* sp., 32%, 23%; coccidial oocysts, 0%, 20%.

Bergstrom, R. C.

- 25 1969 Parasites of ungulates in the Jackson Hole area. *In* Report on the activities of the Jackson Hole Biological Research Station, University of Wyoming, Summer, 1969, pp. 4-5.

Based on both necropsy data and fecal examinations, about 8% of the elk examined from Grand Teton National Park were positive for lungworms (*Dictyocaulus* sp.) in January, 1969. Percent incidence of the infection was 32-39% in May, 23-33% in August, and 23-31% in October.

Bergstrom, R. C.

- 26 1970 Parasites of ungulates in the Jackson Hole area. *In* Report on the activities of the Jackson Hole Biological Research Station, University of Wyoming, Summer, 1970, pp. 2-3.

Based on necropsy data and/or fecal examinations, percent incidence of lungworms (*Dictyocaulus* sp.) was as follows: January, 18%; May, 32%; August, 30%; October, 30%. Rates of infection varied markedly in different areas during the summer, with Refuge elk nearly 100% infected, whereas Teton Park elk showed a 30% incidence and "high country" elk 12% incidence. Some infected elk showed extensive emphysema.

Bergstrom, R. C.

- 27 1971 Parasites of ungulates in the Jackson Hole area. *In* Report on the activities of the Jackson Hole Biological Research Station, University of Wyoming, Summer, 1971, pp. 9-10.

Studies on the incidence of lungworms (*Dictyocaulus* sp.) at intervals during the year indicated that 40% of the elk examined were infected in May, 1971 and 47% were positive in August. In October, 70% of the elk collected by hunters were infected with lungworms. A 12% incidence was found in elk on Big Game Ridge in mid-July, 1971.

Bergstrom, R. C.

- 28 1975 Prevalence of *Dictyocaulus viviparus* infection in Rocky Mountain elk in Teton County, Wyoming. *J. Wildl. Dis.* 11: 40-44.

The prevalence of lungworms infections was monitored in elk herds on Big Game Ridge and on the National Elk Refuge

at intervals during the period 1969-73. Seasonal prevalence varied as follows: 32-70%, spring; 30-47%, summer; 21-39%, fall; and 8-19%, winter. A decreased prevalence resulted in animals at the N.E.R. after elk were not permitted to spend the summer on the Refuge. Pathology noted in infected lungs ranged from slight interstitial hyperplasia to extensive emphysema and abscess formation.

Bird, R. D.

- 29 1933 A three-horned wapiti (*Cervus canadensis canadensis*). J. Mammal. 14(2):164-166.

Review of history and stocking of Wichita National Forest and Game Preserve, Comanche County, Oklahoma, with bison and wapiti. On Oct. 22, 1932, the author killed a male wapiti with 3 antlers. The right was normal and bore 5 points; on the left were 2 distinct antlers — one lacked brow tine and had no burr; two inches in front of it and over the left eye was a well-developed third antler with four tines and a burr. The skin was infected at the base of the left horns. There were no internal parasites, but 4 ticks were found: 1 male and 2 female *Dermacentor albipictus* Pack. and 1 male *Ixodes scapularis* Say. This was a new record for the state.

Bishopp, F. C. and H. L. Trembley

- 30 1945 Distribution and hosts of certain North American ticks. J. Parasitol. 31:1-54.

Host-parasite records for elk (*Cervus canadensis occidentalis*) include *Dermacentor albipictus* (Packard). Moose and elk die from gross infestations of the winter tick, *D. albipictus*, combined with feed shortages in late winter and early spring.

Bishopp, F. C. and H. P. Wood

- 31 1913 The biology of some North American ticks of the genus *Dermacentor*. Parasitol. 6:153-187.

Dermacentor albipictus was found commonly on elk in Montana and Wyoming from 1910-1912.

Blair, W. R.

- 32 1903 Internal parasites in wild animals. 8th Ann. Rept. New York Zool. Soc.

Strongylus filaria in elk and red deer.

Blair, W. R.

- 33 1905 Report of the Medical department. 10th Ann. Rept. New York Zool. Soc., pp. 138-143.

Bronchopneumonia in elk due to *filaria*.

Boddicker, M. L. and E. J. Hughhins

- 34 1969 Helminths of big game mammals in South Dakota. J. Parasitol. 55(5):1067-1074.

Twenty elk from Custer State Park and vicinity (Custer Co., S. Dak.) were examined at post-mortem. The following parasites were found: *Dictyocaulus viviparus* (10% infected); *Nematodirella longissimespiculata* (5% infected); *Nematodirus helvetianus* (5% infected); *Oesophagostomum venulosum* (80% infected); *Trichuris ovis* (10% infected); *Moniezia benedeni* (5% infected); and *Thysanosoma actinioides* (25% infected). *N. longissimespiculata* and *N. helvetianus* were new host records.

Brazda, A. R.

- 35 1953 Elk migration patterns, and some of the factors affecting movements in the Gallatin River Drainage, Montana. J. Wildl. Mgmt. 17(1):9-23.

A study of tabanid populations for certain localities on the summer range indicated an inverse relationship between tabanid numbers and elk numbers. The following tabanids and other blood-sucking flies were thought to be involved: *Chrysops furcata*, *C. noctifera*, 7 spp. of *Hybomitra*, *Haemotobia serrata*, *Muscina assimilis*, *Glaucops fratellus*, *Atylotus incisuralis*, 2 spp. of *Symphoromia*.

Brooks, H.

- 36 1901 Report of the pathologist. 6th Ann. Rept. New York Zool. Soc., pp. 108-119.

Mischerschen schleuche found in myocardium of elk.

Butler, W. J.

- 37 1938 Wild animal disease investigation. Montana Livestock San. Bd. Rept., 1936-1938, p. 14.

Post-mortem examinations of 5 elk shot by hunters along the south fork of the Flathead River in 1937 indicated that 2 were infected with flukes (probably *Fascioloides magna*), and 1 had about 50 lungworms (*Dictyocaulus hadweni*) in the bronchi.

Caballero, y C., E.

- 38 1945 Morfologia y posicion sistematica de *Onchocerca cervipedis* Wehr & Dikmans, 1935. Rev. Brasil. Biol. 5(4):557-562.

Wehrdikmansia cervipedis (Wehr & Dikmans, 1935) found in *Cervus canadensis* in Missoula, Thompson River, Kalispell, Mont.; also in British Columbia, Oregon, Washington, Pennsylvania, Washington, D.C. and Idaho, p. 560.

Cameron, A. E. and J. S. Fulton

- 39 1927 A local outbreak of the winter or moose tick, *Dermacentor albipictus* Pack. (Ixodoidea) in Saskatchewan. Bull. Entomol. Res. 17(3):249-257.

This tick is a parasite of *Alces machlis*, *Cervus canadensis*, and *Odocoileus virginianus*. Fifteen dead moose, all tick infested, found on one trip. Species figured and life history described.

Cameron, T. W. M.

- 40 1935 Animal parasites and wildlife. Trans. Amer. Game Conf. 21:412-417.

Mentions the role of wild elk as probably the original source of the fringed tapeworm which commonly occurs in sheep, p. 314.

Cameron, T. W. M.

- 41 1968 Northern sylvatic helminthiasis. Arch. Environmental Hlth. 17(4):614-621.

Elk (*Cervus canadensis*) serve as intermediate hosts for *Echinococcus granulosus* in the sylvatic cycle which occurs in the 5 western provinces of Canada and the adjacent states in the U. S.

Cameron, T. W. M. and G. A. Webster

- 42 1961 The ecology of hydatidosis. In May, J. M., ed., Studies in Disease Ecology. Hafner Pub. Co., New York, p. 153.

American elk (*Cervus canadensis*) frequently show pulmonary infection from hydatid cysts of *Echinococcus granulosus* in Alaska and northern Canada.

Canavan, W. P. N.

- 43 1929 Nematode parasites of vertebrates in the Philadelphia zoological garden and vicinity. Parasitol. 21(½):63-102.

Lists the following parasites recovered from *Cervus canadensis* maintained in the Philadelphia zoo in the period 1903-1923: 2 of 29 infected with *Trichuris* sp.

Canavan, W. P. N.

- 44 1931 Nematode parasites of vertebrates in the Philadelphia zoological garden and vicinity. II. Parasitol. 23(2):196-229.

Trichuris sp. was found in intestines of *Cervus canadensis* in Philadelphia zoo, p. 199.

Carpenter, J. W., H. E. Jordan and B. C. Ward

- 45 1973 Neurologic disease in wapiti naturally infected with meningeal worms. *J. Wildl. Dis.* 9:148-153.

Four wapiti (*Cervus canadensis*) from Oklahoma which had shown clinical signs of neurologic disease were infected with meningeal worms (*Parelaphostrongylus tenuis*). Lesions found in the brain of these animals were focal meningitis, perivascular cuffing and focal gliosis. Sixteen wapiti shot by hunters in the Wichita Mountains Wildlife Refuge were negative for meningeal worms.

Cass, J. S.

- 46 1947 Buccal food impactions in white-tailed deer and *Actinomyces necrophorus* in big game. *J. Wildl. Mgmt.* 11(1):91-94.

Lists the following reports of necrobacillosis in elk: Murie (1930): report on necrobacillosis of elk in Jackson Hole, Wyo.; Rush (1932): report of 12 elk which had died in the northern Yellowstone herd from necrobacillosis; Murie et al. (1944) reported death of 1,046 elk on feedground at Jackson Hole, mainly from necrotic stomatitis.

Chapin, E. A.

- 47 1925 New nematodes from North American mammals. *J. Agric. Res.* 30: 677-681.

Dictyocaulus hadweni found in moose, elk and bison. Type specimens from bison appeared to be same species as specimens from moose and elk.

Choquette, L. P. E.

- 48 1956 Significance of parasites in wildlife. *Can. J. Comp. Med.* 20: 418-426.

Contains references to serious diseases in elk which are caused by the large liver fluke, *Fascioloides magna* and the lungworm, *Dictyocaulus viviparus*. The hydatid cyst of *Echinococcus granulosus* also occurs in elk and in severely affected animals can be pathogenic due to destruction of lung tissue.

Choquette, L. P. E., G. G. Gibson, and B. Simard

- 49 1971 *Fascioloides magna* (Bassi, 1875) Ward, 1917 (Trematoda) in woodland caribou, *Rangifer tarandus caribou* (Gmelin), of north-eastern Quebec, and its distribution in wild ungulates in Canada. *Can. J. Zool.* 49:280-281.

Reviews the distribution of the giant liver fluke in Canada, including elk infections in western Canada, in the national parks of the Canadian Rockies, and in Ontario.

Clark, K. A.

- 50 1973 Neoplasms of wild animals. Southwest. Vet. 26: 185-188.

Lists osteogenic sarcoma as a type of neoplasm occurring in elk.

Claus, K. D.

- 51 1962 Survey of *Clostridium hemolyticum* in elk. Vet. Res. Lab., Montana State College, Bozeman, Mont. 2 pp. (Unpub. lab. notes).

Serum from 654 slaughtered elk were tested for *Cl. hemolyticum* agglutinins, for which 50 or 7.6% were positive.

Coffey, M. D.

- 52 1954 A study of some Rocky Mountain spotted fever vectors and their hosts in Utah. Great Basin Nat. 14(1-2):31-37.

Reports the winter tick, *Dermacentor albipictus*, collected from elk in Cache County, Utah (no specific data given).

Colwell, D. A. and J. S. Dunlap.

- 53 1975 Psoroptic mange in a wapiti. J. Wildl. Dis. 11:66-67.

A ten year-old bull elk from the lower Lochsa River drainage in northern Idaho died showing signs of ataxia and alopecia affecting about two-thirds of the body. Large numbers of mites (*Psoroptes equi* var. *cervinus*) were found on depilated areas on the body surface.

Cooley, R. A.

- 54 1932 The Rocky Mountain wood tick. Mont. Agric. Exp. Sta. Bull. 268:32.

Elk are hosts of the adult ticks in the mountains and play a secondary part as hosts in central Montana except remote areas. Bulletin covers northern Rocky Mountain region in Canada and the United States.

Cooley, R. A.

- 55 1938 The genera *Dermacentor* and *Otocentor* (Ixodidae) in the United States, with studies in variation. Nat. Inst. of Health Bull. 171: 1-89.

This is a well illustrated monographic treatment of these important genera. *Dermacentor andersoni* and *Dermacentor albipictus* are listed as common parasites on deer, elk, and moose.

Corner, A. H. and R. Connell

- 56 1958 Brucellosis in bison, elk and moose in Elk Island National Park, Alberta, Canada. *Can. J. Comp. Med.* 22(1): 9-20.

Serological specimens from 343 bison, 221 elk and 124 moose were examined for brucellosis. Of 221 samples from elk 25 were positive, 34 suspect and 198 were negative. The authors feel that infected elk may play a role in the transmission to domestic cattle outside of parks. Studies of brucellosis in wildlife should be extended to other species and areas.

Corson-White, E. P.

- 57 1927 Spinal cord diseases. *Lab. and Mus. Compar. Path. Report*, Zool. Soc. Philadelphia. pp. 28-31.

Diffuse, bilateral degeneration had occurred in the spinal cord of 3 *Cervus canadensis* from the Philadelphia Zoological Garden. At necropsy no evidence was found of infectious processes or inflammatory reactions. Etiology was unknown.

Cowan, I. M.

- 58 1948 The occurrence of the granular tape-worm (*Echinococcus granulosus*) in wild game in North America. *J. Wildl. Mgmt.* 12(1):105-106.

Two of three wapiti (*Cervus canadensis*) were infected with hydatid cysts in 1944, and in 1945 the lung tissue of one wapiti was found to be almost completely replaced with hydatid cysts while a senile mule deer was infected with 6 pulmonary cysts.

Cowan, I. M.

- 59 1950 Some statistics of big game on overstocked mountain range. *Trans. N. Am. Wildl. Conf.* 15:581-588.

The author concluded that malnutrition, winter ticks, internal parasites and predatory animals comprised the most important checks on large wild ruminants (including elk) in the Banff, Jasper, Kootenay and Yoho National Parks area of Alberta and British Columbia.

Cowan, I. M.

- 60 1951 The diseases and parasites of big game mammals of western Canada. *Rept. Proc. 5th Ann. B.C. Game Conv.*: 37-64.

Actinomycosis and tuberculosis were prevalent in elk (*Cervus canadensis nelsoni*) and the following parasites were recorded: *Cysticercus tenuicollis*, *Echinococcus granulosus*, *Fascioloides magna* and *Dictyocaulus viviparus*.

Davies, R. B. and G. G. Clark

- 61 1974 Trypanosomes from elk and horse flies in New Mexico. J. Wildl. Dis. 10:63-65.

A *Trypanosoma* sp. was isolated from 5 of 7 yearling elk which had been transported from Jackson Hole, Wyoming to the Red Rock Wildlife Area in New Mexico. This is apparently only the second report of trypanosomes in elk.

Davis, R. W. and Y. Z. Abdelbaki

- 62 1964 Investigations of diseases of elk. Arizona Game and Fish Dept. Job Compl. Rept. Proj. W-78-R-8.

Eyes and brains were removed from normal and blind elk and both gross and microscopic examinations were made in order to determine if pathological changes were present which were responsible for blindness in Arizona elk.

Davis, R. W., Y. Z. Abdelbaki and J. L. Adcock

- 63 1965 Investigation of diseases of elk. Arizona Game and Fish Dept. Job Comp. Rept. Proj. W-78-R-9.

Macroscopic and microscopic studies were continued on normal and pathologic eyes from elk. Studies were initiated on brains from blind elk. Measurements of the bony orbit and optic foramina were obtained from skulls prepared from normal animals. The cephalic index was established for the various skulls examined. A blind bull elk was bred to 2 blind cow elk in an effort to study the genetic aspects of the disease.

Davis, R. W., Y. Z. Abdelbaki, J. L. Adcock and C. P. Hibler

- 64 1966 Investigations of diseases of elk. Arizona Game and Fish Dept. Job Comp. Rept. Proj. W-78-R-10.

A nematode, tentatively identified as *Elaeophora schneideri*, was found in the blood vessels of brains of blind animals collected during the course of the investigation. Fundoscopic examination of blind elk in captivity showed various stages of retinal degeneration.

Denney, R. N.

- 65 1964 Study of diseases and parasites. Colorado Dept. of Game, Fish, and Parks. Job Comp. Rept. Proj. W-38-R-17, pp. 26-35.

A total of 80 blood samples from Colorado elk were negative for brucellosis and leptospirosis. Lung tissue samples from 25 elk were negative for lungworm eggs or larvae. One cow elk was found to have a brain neoplasm causing partial blindness. Another elk had fractured bones of the feet, and a young bull elk had a general infection resulting from a compound fracture of the metatarsus.

Denney, R. N.

- 66 1965 Study of diseases and parasites (deer-elk). Colorado Dept. of Game, Fish and Parks. Job Comp. Rept. Proj. W-38-R-18, pp. 59-62.

Blood samples for 163 elk examined during the period of 1961-1964 were all negative for brucellosis and leptospirosis. Lung tissue samples from 25 elk collected in the period April 1, 1963 - March 31, 1964 were negative for lungworm eggs or larvae.

Diamant, G. and R. K. Strickland

- 67 1965 Manual on livestock ticks. U.S. Agri. Res. Serv. ARS 91-49. 142 pp.

Lists the following livestock ticks that occur also on elk:
Dermacentor albipictus and *Otobius megnini*.

Dikmans, G.

- 68 1931 Two new lungworms from North American ruminants and a note on the lungworms of sheep in the United States. Proc. U.S. Nat. Mus. 79-(18):1-4.

Records *Dictyocaulus hadweni* from elk in Yellowstone Park.

Dikmans, G.

- 69 1936 A note on *Dictyocaulus* from domestic and wild ruminants. J. Wash. Acad. Sci. 26(7):298-303.

Dikmans considers *Dictyocaulus hadweni* from *Cervus canadensis* to be synonymous with *D. viviparus*.

Dikmans, G.

- 70 1939 Helminth parasites of North American semidomesticated and wild ruminants. Proc. Helminth. Soc. Wash. 6(2): 97-101.

Internal parasites reported from elk are: *Ostertagia circumcincta*, *Oesophagostomum venulosum*, *Dictyocaulus viviparus*, *Setaria* sp., *Fascioloides magna*, *Thysanosoma actinioides* and *Echinococcus*. Contains literature review for early elk parasite surveys.

Drake, C. H.

- 71 1951 Mistaken diagnosis of actinomycosis for osteogenic sarcoma in an American elk (*Cervus canadensis*). J. Wildl. Mgmt. 15(3):154-287.

A field diagnosis of actinomycosis in a dead elk was proven in the laboratory to be an osteogenic sarcoma. Emphasized the dangers of field diagnoses unsupported by confirmation.

Dutson, V. J., J. N. Shaw and S. E. Knapp

- 72 1967 Epizootiologic factors of *Fascioloides magna* (Trematoda) in Oregon and southern Washington. Am. J. Vet. Res. 28:853-860.

Three infected elk from the Cascade Mountains were positive for *F. magna* by post-mortem examination and 90.5% of 21 fecal samples from Lane County were positive for fluke eggs. These were all from central Oregon Cascade Mountains area and included both Rocky Mountain elk and Roosevelt elk.

Ellis, L. L., Jr.

- 73 1955 A survey of the ectoparasites of certain mammals in Oklahoma. Ecology 36(1):12-18.

One Rocky Mountain elk (*Cervus canadensis nelsoni*) from the Wichita Mountains area of Oklahoma was parasitized by 5 winter ticks (*Dermacentor albipictus*).

Emerson, K. C.

- 74 1962 A tentative list of Mallophaga for North American mammals (north of Mexico). (Aug. 15). 20 pp. Dugway, Utah.

The following synonymy of species found on elk is given: *Bovicola similis* Denny, 1842 and *B. americanum* Jellison, 1935 = *B. longicornis* (Nitzsch, 1818).

Enigk, K. and J. Hildebrandt

- 75 1969 Zur Empfänglichkeit der Wiederkäuer für *Dictyocaulus viviparus* und *Dictyocaulus filaria* (Strongyloidea, Nematoda). Zbl. Vet. Med. 16 B:67-76.

Lists wapiti (*Cervus elaphus canadensis*) and Roosevelt elk (*Cervus canadensis roosevelti*) as hosts of the lungworm *Dictyocaulus viviparus*.

Eveleth, D. F. and F. M. Bolin

- 76 1955 Parasitic gastritis of elk. J. Wildl. Mgmt. 19(1):152.

A mature cow elk which had been held in captivity on a farm near Moorhead, Minnesota became emaciated and was euthanatized. At necropsy, the abomasal mucosa was inflamed, and many specimens of *Trichostrongylus axei* were recovered from mucosal smears.

Fashingbauer, B. A.

- 77 1965 The elk in Minnesota. In Moyle, J. B. ed. Biggame in Minnesota. Minn. Div. Game & Fish. Tech. Bull. 9:99-132.

External parasites found in elk were: biting flies, winter ticks and scab mites. Internal parasites found were: tapeworms and roundworms (infrequent and not considered a menace); *Fascioloides magna* (giant liver fluke) (prevalent in some segments of Minnesota deer habitat but not known in Rocky Mountain elk); and *Sarcocystis*. Other diseases found were: hemorrhagic septicemia, *Staphylococcus* infections, arthritis (common in older animals), brucellosis, and necrotic stomatitis (considered most important elk disease).

Follis, T. B.

- 78 1972 Reproduction and hematology of the Cache elk herd. Utah State Div. Wildl. Res. Pub. no. 72-8. 133 pp.

The occurrence of larvae of lungworms (*Dictyocaulus* sp.) in fecal pellets of elk at the Hardware Ranch in northeastern Utah was correlated with confinement. In captive elk the prevalence of lungworms varied from 13 to 78%. In free-ranging animals, only 1 positive animal was found in a total of 78 animals examined.

Flook, D. R. and J. E. Stenton

- 79 1969 Incidence and abundance of certain parasites in wapiti in the national parks of the Canadian Rockies. Can. J. Zool. 47:795-803.

Results of detailed autopsies of 107 elk from Banff and Kootenay National Parks and Ya Ha Tinda Ranch from 1961-1963 and additional findings from 1380 elk collected from 1958-1967 in Jasper, Banff and Waterton Lakes Parks are included. Giant liver flukes (*Fascioloides magna*) were found in animals from several areas. Fringed tapeworms (*Thysanosoma actinioides*) were found in several areas and were about equally common at all seasons of the year. They were significantly more common in calves, yearlings and 2 year olds than in older age groups of elk. Pulmonary hydatid cysts (*Echinococcus granulosus*) were found in only 1 aged female elk in the research series (107 animals), but cysts were common in lungs examined from the slaughter series (1380 animals). Thread lungworms (*Dictyocaulus viviparus*) occurred in wapiti from all areas, with no difference in the rate of infection between sexes or among the different age classes. Biting lice (*Damalinia concavifrons*) were found on 12 of 51 wapiti examined for their presence. Winter ticks (*Dermacentor albipictus*) were present on wapiti from all areas of the collection from October through June. The common tapeworm (*Moniezia benedeni*) was noted in only 1 elk. Whipworms (*Trichuris ovis*) were found in 2 wapiti. One peritoneal nematode (*Setaria cervi*) was found during the study. Larvae of the deer nose fly (*Cephenemyia jellisoni*) were found in 2 elk.

Fox, H.

- 80 1923 Disease in captive wild mammals and birds; incidence, description, comparison. J. B. Lippincott, Philadelphia. 665 pp.
Of 29 elk autopsied at the Philadelphia Zoological Garden between 1901 and 1923, 2 (or 7%) were infected with *Trichocephalus (Trichuris)* (no species given). P. 631.

Fox, H.

- 81 1928 Parasites. Rept. Lab. and Mus. Comp. Path. Zool. Soc. Philadelphia. pp. 31-33.
Haemonchus contortus in elk in the Philadelphia zoo.

Fyvie, A.

- 82 1969 Manual of common parasites, diseases and anomalies of wildlife in Ontario. 2nd ed. Ontario Dept. of Lands and Forest, Toronto. 102 pp.
The following parasites are listed as occurring in elk in Ontario: large American liver fluke (*Fascioloides magna*); thin-necked bladderworm (*Cysticercus tenuicollis*); hydatid cyst (*Echinococcus granulosus*); winter tick (*Dermacentor albipictus*); meningeal worm (*Pneumoststrongylus tenuis*).

Gaffney, W. S.

- 83 1941 The effects of winter elk browsing, south fork of the Flathead River, Montana. J. Wildl. Mgmt. 5(4):427-453).
Includes the following comments on parasites and diseases. Livers from mature elk killed during hunting season are frequently infected with liver fluke (*Fasciola*). Wood ticks (probably *Dermacentor albipictus*) are found on most of the animals after February and in some instances the death of young elk has been attributed to these infestations. The deer botfly (*Cephenomyia*) has been found in elk, and a species of tapeworm has been found.

Gemmell, M. A.

- 84 1960 Advances in knowledge on the distribution and importance of hydatid disease as world health and economic problems during the decade. Helminth. Abst. 29:355-369.
Review article with 6 pages of references. Hydatid disease in American elk-wapiti (*Cervus canadensis*) has been reported by various authors during the last decade.

Graf, W.

- 85 1955 The Roosevelt elk. Port Angeles Evening News, Port Angeles, Wash. 105 pp.

Reviews parasite records reported by Schwartz (1945) from necropsies on 32 Roosevelt elk in the Olympic Mountains. Seventy-two percent were infected with lungworms. The giant liver fluke (*Fascioloides magna*) was commonest in elk from the south fork of the Hoh River, where the incidence was 81%. *Sarcocystis* was found in the hearts of about 40% of the elk shot by hunters. Fringed tapeworms (*Thysanosoma actinioides*), nodular worms (*Oesophagostomum venulosum*) and whipworms (*Trichuris* sp.) were common. The tick *Dermacentor albipictus* was the most widely distributed parasite. Other ectoparasites present were biting lice (*Bovicola americanum*) and bot fly larvae (*Cephenomyia* sp.). Necrotic stomatitis resulting from *Bacillus necrophorus* infection was the most important bacterial disease.

Green, H. U.

- 86 1949 Occurrence of *Echinococcus granulosus* in elk (*Cervus canadensis nelsoni*) in Banff National Park. Can. Field-Nat. 63(5):204-205.

The annual incidence of hydatid cysts in a grand total of 1073 wapiti (*Cervus canadensis*) in Banff National Parks from 1944 to 1948 varied from 1.7% to 6.8%. All 177 calves were negative, and only 2 of 130 yearlings were infected. Almost all the infections were seen in animals 7 years old and older. One to 3 cysts, rarely more, were seen and these varied in diameter from 2 to 90 mm.

Greer, K. R.

- 87 1968 Yellowstone elk study, 1967-68. Montana Fish and Game Dept. Job Comp. Rept. Proj. W-83-R-11. 26 pp.

Forty-one percent of 181 elk from the northern Yellowstone Park herd which were examined at post-mortem during the months of January through March, 1967, and December through March, 1967-68, were infected with fringed tape-worms (*Thysanosoma actinioides*). Seasonal prevalence of lungworms (*Dictyocaulus viviparus*) was as follows: Dec. 1967, 40% (10/25); Jan. 1968, 22% (10/46); Feb. 1968, 23% (3/13); March, 1968, 0% (0/0). Specimens of the spinose ear tick (*Otobius megnini*) were found in the ear canals of two yearling cow elk collected on January 24-25, 1968.

Gregson, J. D.

- 88 1956 The Ixodoidea of Canada. Canada Dept. Agric., Sci. Serv., Entomol. Div. Publ. 930. 92 pp.

Elk host-parasite associations were recorded as follows: *Dermacentor albipictus* (Packard) in Rocky Mountain elk (*Cervus canadensis nelsoni* Bailey).

Grobov, O. F.

- 89 1961 The susceptibility of the elk to anaplasmosis of cattle. (In Russian). Veterinariya, Moscow, (9):50.

A young elk heavily infested with ticks, probably *Ixodes ricinus*, at 15-25 days of age, had no parasites in the blood. It was then inoculated s/c with 60 ml. of blood from a cow with anaplasmosis. After 47 days 0.011% of erythrocytes contained anaplasma bodies and by the 63rd day the maximum infestation (0.62% of erythrocytes infected) occurred. At this time the C.F. test was positive and there were changes in the morphology and composition of the blood, but the elk was not very ill. Blood taken on the 106th day produced typical anaplasmosis in a calf.

Gubanov, N. M.

- 90 1965 Filariids of mammals of economic importance in the Yakutsk region. In Parasitic worms of domestic and wild animals: Papers on helminthology presented to Prof. A. A. Sobolev on the 40th anniversary of his scientific and teaching activity. (In Russian). Vladivostok: Dalnevostochnii Gosudarstvennii Universitet, pp. 71-77.

Filariids described and figured from various animals of economic importance in the Yakutsk region, USSR, include *Acanthospiculum flexuose* from *Cervus elaphus*, *A. cervipedis* from *Rangifer tarandus* and *Cervus canadensis xanthopygus*, *Alcefilaria abramaovi* from *Alces alces*, and *Acanthospiculum jakutensis* n. sp. from *Cervus canadensis xanthopygus*.

Hadwen, S.

- 91 1932 "Notes". J. Parasitol. 19:83.

Hadwen reports *Echinococcus granulosus* from a moose (*Alces alces*) at Le Pas, Manitoba, and the cysticercus of *Taenia hydatigena* from *Cervus elaphus* at Wainwright, Alberta. No details are given. (The latter host may well be the wapiti *Cervus canadensis*, rather than the European deer *Cervus elaphus*).

Hall, M. C.

- 92 1930 Parasites of elk and other wild ruminants. J. Wash. Acad. Sci. 20(5):87-88.

Fasciola magna found in the fourth stomach of one elk. No other specific references to diseases of elk but several parasites of ruminants mentioned in author's abstract of oral address.

Hall, M. C.

- 93 1934 Outline for a campaign against the common Sheep Liver Fluke and the large American Cattle Fluke in the United States. N. Am. Vet. 15:48-55.

The large American Cattle Fluke was first discovered in an American elk in Italy. They also live in livers of deer and other wild ruminants.

Halloran, P. O.

- 94 1955 Bibliography of references to diseases of wild mammals and birds. Am. J. Vet. Res. 16(61, pt. II): 1-465.

Includes references to diseases and anomalies of elk arranged according to disease type and systems affected.

Hardcastle, A. B.

- 95 1943 A check list and host-index of the species of the protozoan genus *Eimeria*. Proc. Helminth. Soc. Wash. 10(2):35-69.

Records of *E. hegneri* Rastegaieff and *E. zumii* (Rivolta) from elk.

Harper, T. A., R. A. Ruttan and W. A. Benson

- 96 1955 Hydatid disease (*Echinococcus granulosus*) in Saskatchewan big game. Trans. 20th N.A. Wildl. Conf. pp. 198-208.

Partial examination of lungs and liver for 2 wapiti were negative for echinococcus and hydatid cyst.

Henshaw, H. W. and C. Birdseye

- 97 1911 The mammals of Bitterroot Valley, Montana, in their relation to spotted fever. U.S. Dept. Agric. Bureau Biol. Survey. Circ. no. 82. 24 pp.

Elk in the Bitterroot area are thought to harbor the adult stage of the spotted fever tick, *Dermacentor venustus*, but none was found on a cow elk shot in May, 1910 at Lake Como, Ravalli County.

Hepworth, W. G.

- 98 1963 Diagnosis of diseases in mammals and birds. Wyoming Game and Fish Comm. Job Compl. Rept. Proj. FW-3-R-10, p. 13.

A clostridial septicemia suggestive of malignant edema was diagnosed in 3 elk which died at the Sybille Experiment Unit.

Hepworth, W. G.

- 99 1964 Study of brucellosis in game animals. Wyoming Game and Fish Comm. Job Compl. Rept. Proj. FW 3-R-11, pp. 37-38.

Of 167 elk tested for *Brucella* antibodies by plate agglutination, 2 reactors and 3 suspected reactors were found. No aborted elk fetuses were examined during the year.

Hepworth, W. G. and G. M. Thomas

- 100 1962 Attempts to transfer psoroptic mites from elk to cattle and sheep. J. Am. Vet. Med. Assoc. 140:689-690.

Elk skin scrapings containing a large number of live elk scabies mites were affixed to the hair of 3 calves and the wool of 3 sheep and placed in the ears of 2 calves and 2 sheep. Careful examination 6 and 12 weeks later did not reveal live mites and indicated that the mites had not transferred.

Hibler, C. P. and J. L. Adcock

- 101 1968 Redescription of *Elaeophora schneideri* Wehr and Dikmans, 1935 (Nematoda: Filarioidea). J. Parasitol. 54(6):1095-1098.

The arterial worm, *E. schneideri*, is reported from elk for the first time. Infected animals were found in Gila and Navaho Counties, Arizona; Grant and Catron Counties, New Mexico; Arthuleta County, Colorado; and Albany County, Wyoming. Specimens from elk were smaller than those from sheep and deer.

Hibler, C. P. and J. L. Adcock

- 102 1971 Elaeophorosis. In Davis, J. W. and Anderson, R. C. editors. Parasitic diseases of wild mammals. Iowa State University Press. Ames, Iowa, pp. 263-278.

Summarizes present knowledge of the hosts, distribution, vectors, transmission, development, pathology, pathogenesis, diagnosis, treatment and control of *E. schneideri* infections. This filarial nematode is known to occur in domestic sheep, deer and elk in the western United States, primarily in animals ranging at elevations above 6000 feet. In elk, intra-arterial infections of the leptomenigeal and carotid arteries produce blindness, damage to the central nervous system, facial necrosis and death.

Hibler, C. P., J. L. Adcock, R. W. Davis and Y. Z. Abdelbaki

- 103 1969 Elaeophorosis in deer and elk in the Gila Forest, New Mexico. Bull. Wildl. Dis. Assoc. 5(1):27-30.

In New Mexico elaeophorosis in elk caused by *Elaeophora schneideri* has become very prevalent. Species of *Hybomitra* and *Tabanus* are intermediate hosts for *E. schneideri* and their high incidence makes it unlikely that any deer or elk in the Gila Forest could escape exposure to infection.

Hibler, C. P. and C. J. Metzger

- 104 1974 Morphology of the larval stages of *Elaeophora schneideri* in the intermediate and definitive hosts with some observations on their pathogenesis in abnormal definitive hosts. J. Wildl. Dis. 10: 361-369.

In abnormal definitive hosts such as *Cervus canadensis*, larvae of *E. schneideri* remain in the leptomeningeal arteries for 5 weeks or longer, initiating the clinical manifestations of elaeophorosis.

Hoff, G. L. and D. O. Trainer

- 105 1973 Experimental infection in North American elk with epizootic hemorrhagic disease virus. J. Wildl. Dis. 9:129-132.

Two elk (*Cervus canadensis*) which were inoculated intravenously with epizootic hemorrhagic disease virus showed no overt signs of disease, although one had a slight febrile response. A cell associated viremia was detected in both animals.

Honess, R. F.

- 106 1955 The *Eimeria* of elk, *Cervus canadensis nelsoni*, with a description of a new species. Wyoming Game & Fish Comm. Bull. 8(4):25-28.

Describes *Eimeria wapiti* as a new species in elk. Lists 11 references concerned with internal parasites of deer, elk and other ruminants. Offers a key to identification of 12 species of *Eimeria* found in deer and elk.

Honess, R. F. and K. B. Winter

- 107 1956 Diseases of wildlife in Wyoming. Wyoming Game & Fish Comm. Bull. 9. 279 pp.

Discusses enterotoxemia, necrotic stomatitis, infections of *Corynebacterium pyogenes* and internal and external parasites. The authors believed that brucellosis was spread from domestic cattle to buffalo, which in turn spread it to elk. They refer to 110 buffalo tested for brucellosis, of which 58 were positive and 25 suspicious, and to 32 elk using the same range, of which 3 were positive and 8 suspicious.

Howe, D. L.

- 108 1964 Study of anaplasmosis in game animals. Wyoming Game & Fish Comm. Job Compl. Rept. Proj. FW-3-R-11, pp. 19-36.

Anaplasma marginale or *A. ovis* were not detected in 136 elk which were tested by inoculation of pooled blood samples into calves and sheep.

Howe, D. L.

- 109 1965 Diagnosis of diseases in mammals and birds. Wyoming Game & Fish Comm. Job Compl. Rept. Proj. FW-3-R-12, pp. 14-15.

A bull elk which died on its winter feedground in Sublette County was found at necropsy to have a systemic *Clostridium* infection which resembled malignant edema.

Howe, D. L.

- 110 1965 Investigation of insecticides when used to control winter ticks. Wyoming Game & Fish Comm. Job Compl. Rept. Proj. FW-3-R-12, pp. 56-62.

Tests of a number of chemicals indicated that aerial application of an organic phosphate insecticide, oral use of systemic insecticides, or use of salt containing sulfur were all ineffective in reducing infestation with *Dermacentor albipictus* on wintering elk.

Howe, D. L.

- 111 1965 Study of scab mite in elk. Wyoming Game & Fish Comm. Job Compl. Rept. Proj. FW-3-R-12, pp. 65-67.

Hair and skin scrapings from elk infested with psoroptic mites were attached to three domestic sheep and 3 domestic calves. No transfer or establishment of mites was observed on the sheep or calves. The incidence of mange-like lesions on elk at the National Elk Refuge was 18% in 1965.

Howe, D. L. and W. G. Hepworth

- 112 1965 Anaplasmosis in big game animals: tests on wild populations in Wyoming. Am. J. Vet. Res. 26:1114-1120.

Blood samples from 316 pronghorn antelope (*Antilocapra americana americana*), 180 mule deer (*Odocoileus hemionus hemionus*), 49 white-tailed deer (*Odocoileus virginianus dacotensis*), and 168 elk (*Cervus canadensis canadensis*) were inoculated into splenectomized calves and sheep to test for *Anaplasma marginale* and *Anaplasma ovis*. The blood samples were pooled by species and locality. All elk samples were negative for *Anaplasma* spp. Complement-fixation tests of 521 serum samples resulted in many non-specific reactions. False positive tests were common with serum samples from antelope (99%) and elk (56%). Blood inoculums from the false reactors failed to transmit anaplasmosis to calves or sheep. *Eperythrozoon* was observed in blood films of inoculated calves and sheep. Latent eperythrozoonosis apparently occurred in mule deer and elk.

Howe, D. L., W. G. Hepworth, F. M. Blunt and G. M. Thomas

- 113 1964 Anaplasmosis in big game animals: experimental infection and evaluation of serologic tests. Am. J. Vet. Res. 25:1271-1276.

Subclinical anaplasmosis, produced experimentally, persisted at least 66 days in pronghorn antelope (*Antilocapra americana*), bighorn sheep (*Ovis canadensis*), and mule deer (*Odocoileus hemionus*), and at least 339 days in elk (*Cervus canadensis*). The C. F. test gave false positive and suspicious reactions when applied to serum samples of known

anaplasma-negative antelope, bighorn sheep, and elk. Attempts to produce a C. F. antigen from blood cells of splenectomized elk failed, apparently because of the relatively low parasitemia. Non-specific absorption complement occurred with antigen prepared from blood cells of splenectomized and intact deer, titrated in the presence of deer, elk, and bovine antisera. Natural eperythrozoonosis was observed in splenectomized elk.

Howell, D. E.

- 114 1940 The ecology of *Dermacentor albipictus* (Packard). Proc. 6th Pacific Sci. Cong. 4:439-458.

Hosts include deer, moose, elk, mountain goat and beaver.

Jacobson, R. H., D. E. Worley and K. R. Greer

- 115 1969 The fringed tapeworm (*Thysanosoma actinioides*) as a parasite of the Rocky Mountain elk in Yellowstone National Park. Bull. Wildl. Dis. Assoc. 5:95-98.

Post-mortem examination of 181 elk (*Cervus canadensis nelsoni*) from the northern Yellowstone Park herd in 1967-68 revealed that 41% were infected with *Thysanosoma actinioides*. Infections occurred in all age classes of animals from seven areas in the Yellowstone, Gardner and Lamar drainages in the northern section of the Park. Prevalence of the parasite was higher in calves and yearlings than in mature elk. Infections varied from 1 to 16 worms per animal, with an average intensity of 4.3 in 75 elk.

Jellison, W. L.

- 116 1935 A new species of *Bovicola* (Mallophaga). J. Parasitol. 21:410-411.

A description of *Bovicola americanum* n. sp. from elk, *Cervus canadensis*, in Wyoming, Washington, and Pennsylvania.

Kadenatsii, A. N.

- 117 1963 On the study of trematodes of ruminants in Khabarovsk krai. Trudy Gel'mint. Lab., Akad. Nauk SSSR, 13:12-17. (In Russian)

Lists the Asian elk (*Cervus canadensis asiaticus*) as a host for the stomach trematode *Fischoederius skrjabini*, which is described and compared with three existing species of the genus.

Karns, P. D.

- 118 1966 *Pneumoststrongylus tenuis* from elk (*Cervus canadensis*) in Minnesota. Bull. Wildl. Dis. Assoc. 2(3):79-80.

Reports new host record, based (apparently) on finding several first stage larvae by Baermann examination of elk feces collected in Marshall County in northwest Minnesota. Identification was based on comparison with Anderson's measurements.

Karstad, L. ed.

- 119 1964, Diseases of the Cervidae: a partly annotated bibliography. Wildl.
1969 Dis. nos. 43 and 52. (On 7 microcards and 2 microfiche).

The 2,063 references, most of which are accompanied by an abstract, are listed both alphabetically under author's name, and by subject. Each reference has a code number, and in the subject index only the code numbers are used. Not only diseases and parasites are covered, by many other subjects such as anatomy, anaesthetics, blood, nutrition, repellents, and reproduction. English translations of foreign titles are not usually given; most of the Russian titles, however, have been translated.

Katz, J. S.

- 120 1941 Brucellosis in wildlife. J. Am. Vet. Med. Assoc. 99:24-27.

Over 200 elk were serologically tested for brucella agglutinins; 5% reacted positively.

Kingscote, A. A.

- 121 1950 Liver rot (fascioloidiasis) in ruminants. Can. J. Comp. Med. 14:203-208.

The history of the large American liver fluke (*Fascioloides magna*) and its life history are briefly reviewed. The results of a survey made in 1949 are given revealing the incidence of the parasite in domestic ruminants and the deer, elk and moose of Ontario. Recommendations are made regarding control measures.

Kingston, N. and J. K. Morton

- 122 1973 Trypanosomes from elk (*Cervus canadensis*) in Wyoming. J. Parasitol. 59:1132-1133.

Of 26 elk held at the Sybille Big Game Research Unit of the Wyoming Game and Fish Commission at Wheatland, 88.5% were infected with trypanosomes. Of 39 other elk examined at Sybille 79.4% were positive. None of 21 elk from the National Elk Refuge at Jackson was found to be infected. Trypanosomes were detected by culturing blood in NNN or VIM media. Specific identity of the cervid trypanosomes was not made. No previous records of *Trypanosoma* sp. exist in elk.

Kingston, N. and J. K. Morton

- 123 1975 *Trypanosoma cervi* sp. n. from elk (*Cervus canadensis*) in Wyoming. J. Parasitol. 61:17-23.

Includes a description of *Trypanosoma cervi*, which was found in the blood of 57 of 65 elk examined at the Sybille Big Game Research Unit, Wheatland, Wyoming in 1972-73. This flagellate was differentiated from related trypanosomes on morphological grounds and was not transmissible to cattle.

Kingston, N. and J. K. Morton

- 124 1975a Recovery of multiplication stages of *Trypanosoma cervi* Kingston and Morton, 1975, in elk spleen. Proc. Helm. Soc. Wash. 42:179-181.

Trypomastigotes believed to be *T. cervi* were recovered from the spleens of 5 elk and the liver of 1 elk.

Knapp, S. E. and J. N. Shaw

- 125 1963 Occurrence of *Fascioloides magna* (Bassi) in Oregon cattle and deer. J. Parasitol. 49:339.

Fascioloides magna is reported for the first time from Oregon cattle. This parasite has also been observed in Oregon deer and elk. The intermediate host for this parasite has not been determined although 3 species of *Stagnicola* (*S. palustris*, *S. bulimoides*, and *S. sp.*) occur in the area where the infected cattle originated.

Lang, E. M.

- 126 1958 Elk of New Mexico. New Mexico Dept. Game & Fish. Bull. no. 8. 33 p.

History, biology, ecology, and management in New Mexico. Status of herd is evaluated from winter aerial survey, bugling counts, sign surveys, and kill data. Biological data are primarily from New Mexico although reports from other areas are cited. Topics include disease and parasites.

Lee, A. M. and M. E. Turner

- 127 1937 A comparison of the tube and plate methods of testing for Bang's disease in elk. J. Am. Vet. Med. Assoc. 90:637-640.

The authors tested the blood sera of 145 elk by the tube and two rapid plate tests. They found that 19% reacted and that the tube test with a 72-hour incubation and a polyvalent antigen was considerably more accurate than the plate or rapid test.

Levine, N. D. and E. R. Becker

- 128 1933 A catalog and host-index of the species of the coccidian genus *Eimeria*. Iowa State Coll. J. Sci. 8(1):83-106.

Eimeria zumii reported from *Cervus canadensis*, p. 93.

Levine, N. D. and V. Ivens

- 129 1970 The coccidian parasites (Protozoa, Sporozoa) of ruminants. Illinois Biological Monographs 44, Univ. of Illinois Press, Urbana, 278 pp.

Lists *Eimeria hegneri*, *E. wapiti* and *E. "zumii"* (*E. "zumii"*) as the species of coccidia reported from *Cervus canadensis*. *E. hegneri* was described from 2 elk in the Leningrad zoo, *E. wapiti* from *C. canadensis nelsoni* in Wyoming, and *E. "zumii"* has been reported from American elk in the Leningrad zoo and from wild elk in Wyoming.

Love, B. I.

- 130 1955 Personal observation in the care and management of an elk (wapiti) herd at Elk Island National Park, Alberta, Canada. Can. J. Comp. Med. 19(6):184-192.

Dermacentor albipictus was found in large numbers on dead and dying winter-kill elk and moose. Animals found debilitated were treated for ticks and they recovered. Coincidentally with the herd reduction the incidence of tick-infested animals decreased from 100% to 3-5%. Autopsies resulted in the condemnation of 18% of the livers as a result of *C. tenuicollis*. Coyote eradication resulted in a decreased incidence to 1%.

Lyubimov, M. P.

- 131 1959 Seasonal dynamics of *Elaphostrongylus* and *Setaria* infections in *Cervus* spp. Trudi Gelmintol. Lab. Nauk SSSR 9:155-156. (In Russian).

Incidence of *Elaphostrongylus* in the brain and spinal cord of *Cervus canadensis asiaticus* was higher during December and February than in August-October, when it decreased to 5-10%.

Magath, T. B.

- 132 1954 The importance of sylvatic hydatid disease. J. Am. Vet. Med. Assoc. 125:411-414.

Magath emphasized the importance of the incidence of *Echinococcus* infestation in wild carnivores and herbivores (including elk) in North America as a reservoir for human hydatid disease. He discussed the ways in which man, by his habits, may acquire infestation from wild animals.

Martyny, J. W. and R. G. Botzler

- 133 1975 *Listeria monocytogenes* isolated from wapiti (*Cervus canadensis roosevelti*. J. Wildl. Dis. 11:330-334.

Listeria monocytogenes (serotypes 1 and 4) were isolated from 14 of 72 wapiti among 4 or 5 herds studied in northwestern California. The pathogenicity of the strains varied with their ability to ferment xylose and rhamnose.

McBee, R. H., J. L. Johnson and M. P. Bryant

- 134 1969 Ruminal microorganisms from elk. J. Wildl. Mgmt. 33(1):181-186.

Rumen contents from four Yellowstone Park elk, killed in the winter of 1962-63, were examined by microscopic and culture methods for the numbers and kinds of bacteria and protozoa present. Total bacterial counts were similar to those of other ruminants. The incidence of various bacterial genera was similar to that of cattle on poor hay. The oligotroph protozoans were species also found in cattle (i.e., *Entodinium* sp., *Eudiplodinium maggii*, *E. maggii* (large race), *Metadinium medium*, and *M. ypsilon*).

McCullough, D. R.

- 135 1969 The Tule elk; its history, behavior and ecology. Univ. Calif. Publ. in Zool. 88:1-209.

Parasite loads in Tule elk apparently were low. Moderate numbers of ticks (no identification given) were found on elk from Owens Valley and Tupman. Cache Creek elk carried large numbers of ticks. Internal parasites were uncommon and no liver flukes were found. In fecal examinations of 50 animals, only one unidentified strongylid egg and one ascarid egg were found. All blood sera from 43 elk from Owens Valley and other area herds of Tule elk were negative for leptospirosis and brucellosis.

McIntosh, A. and W. C. McDuffie

- 136 1956 Ticks that affect domestic animals and poultry. In U.S. Dept. of Agriculture. Yearbook of Agriculture. Animal Diseases, pp. 157-166. U.S. Govt. Print. Off., Washington, D.C.

States that heavy infestations of the winter tick, *Dermacentor albipictus*, may cause death in elk.

Mills, H. B.

- 137 1936 Observations on Yellowstone elk. J. Mammal. 17(3):250-253.

The author gives percentage of pregnancy and records of parasites and diseases among animals killed in process of herd reduction. The following external parasites were found in over 100 elk taken from the Yellowstone elk herd.

Mallophaga (3 animals infested), winter tick (*Dermacentor albipictus*) (on all animals examined) and *Psoroptes* (probably *P. communis ovis*) on 1 elk. Internal parasites found were: *Thysanosoma actinioides* (14 worms in 1 calf elk); coccidia, *Ostertagia*, *Trichuris* (found on fecal analysis). None of the elk were positive for *Dictyocaulus hadweni* or *Cephenomyia* (3 examined). Ten animals showed evidence of necrotic stomatitis and 10 cows had *Sarcocystis* infestations in the heart.

Moore, T.

- 138 1947 A survey of buffalo and elk herds to determine the extent of brucella infection. Can. J. Comp. Med. 11(5):131.

Moore reports the results of agglutination tests of 186 elk and 37 bison sera during the winter of 1946-7. All of the elk sera were negative. Six of the bison sera were positive, five gave doubtful reactions and 26 were negative.

Moschler, A.

- 139 1935 Beobachtungen über die Lebensweise und die Schädlichkeit der Elch rachenbremse, *Cephenomyia ulrichi* Brauer, auf der Kurischen nehrung. Zeit. f. Parasitenk. 7(5):572-578.

Refers to bot fly of European elk.

Murie, O. J.

- 140 1930 An epizootic disease of elk. J. Mammal. 11(2):214-222.

Describes clinical and field aspects of epizootic disease occurring in southern Yellowstone/Jackson Hole elk herd in winter of 1927-28. Losses for the winter estimated at 409 elk. Principal cause was diagnosed as necrotic stomatitis.

Murie, O. J.

- 141 1951 The elk of North America. The Stackpole Co., Harrisburg, Pa. and Wildl. Mgmt. Inst., Washington, D.C. 376 pp.

Parasites and diseases are adequately treated on pp. 163-190. The winter tick (*Dermacentor albipictus*) causes serious harm to elk in certain areas. Scabies (*Psoroptes communis* var. *cervinae*) is also important in some localities. Lice (*Bovicola americanum*), tapeworms (*Thysanosoma actinioides* and *Cysticercus tenuicollis*) are treated summarily. Of the nematodes, *Oesophagostomum venulosum*, *Trichuris* and *Dictyocaulus hadweni* are reported as being parasites of elk. *Fascioloides magna* was found an important parasite in elk of the Olympic Mountains, but not in Rocky Mountain elk. The following diseases are briefly discussed: infectious hepatitis, staphylococcus, *Sarcocystis*, arthritis, tumors, hemorrhagic septicemia and infectious abortion. Necrotic stomatitis is an important mortality factor.

Murray, J. O. and D. O. Trainer

- 142 1970 Bluetongue virus in North American elk. J. Wildl. Dis. 6:144-148.

North American elk (*Cervus canadensis*) were susceptible to experimental bluetongue virus (BTV) infection although clinical signs were mild or inapparent. A viremia of significant magnitude and duration occurred in all 5 experimental elk following subcutaneous inoculation. Elk developed BTV antibody by the 2nd or 3rd week after exposure and antibody was still present in the sera of all animals at the termination of the experiment at 6 or 7 months.

Noback, C. V. and W. Modell

- 143 1930 Direct bone formation in the antler tines in two of the American Cervidae, Virginia deer (*Odocoileus virginianus*) and wapiti (*Cervus canadensis*), with an introduction to the gross structure of antlers. Zoologica, N.Y. 11:19-60.

Novikov, V. K. and A. A. Dubnitski

- 144 1953 Dicrocoeliasis in stags. Karakulev. Zverov. 6(4):78. (In Russian).

The occurrence of *Dicrocoelium dendriticum* in the liver of *Cervus canadensis asiaticus* is reported. The authors believe that this fluke is of pathogenic importance to this animal.

Orr, R. T.

- 145 1937 Notes on the life history of Roosevelt elk in California. J. Mammal. 18:62-66.

Three captive elk in the zoo at Sequoia Park, Eureka, Calif. died from an infection of lung flukes. (Reference to "flukes" is apparently erroneous; believed to refer to lung nematodes).

Pedersen, R. J. and A. A. Pedersen

- 146 1975 Blood chemistry and hematology of elk. J. Wildl. Mgmt. 39(3): 617-620.

Blood samples obtained from 33 free-ranging elk in Umatilla Co., Oregon were examined for 11 hematologic and blood chemistry values. No differences attributable to sex or age were noted for the hematologic values or blood calcium, urea nitrogen, uric acid, cholesterol, total protein, bilirubin or creatine. Significant differences were noted between yearling and adult females for glucose and inorganic phosphorus and between yearling males and adult females for alkaline phosphatase.

Pellerdy, L. P.

- 147 1965 Coccidia and coccidiosis. Akad. Kiado, Budapest. 657 pp.
Eimeria hegneri and *E. wapiti* are listed as parasites of wapiti. *Eimeria wassilewskyi* is considered tentatively as a synonym of *E. hegneri*, although the former has been reported only from *Cervus axis*, *C. elaphus* and *C. nippon hortulorum*.

Philip, C. A. and G. M. Kohls

- 148 1951 Elk, winter ticks, and Rocky Mountain spotted fever: a query. Pub. Hlth. Repts. 66(50):1672-1675.
 A case of Rocky Mountain spotted fever following tick-bite has been reported in which the circumstances strongly incriminate a male winter tick, *Dermacentor albipictus*, off an elk hide as the probable vector. Since this is a well-known, one-host species, the question is raised of the source of this tick's infection.

Porter, D. A. and K. C. Kates

- 149 1956 Tapeworms and bladder worms. In U.S. Dept. of Agriculture. Yearbook of Agriculture. Animal Diseases, pp. 153-156. U.S. Govt. Print. Off., Washington, D.C.
 Reports that the fringed tapeworm (*Thysanosoma actinioides*) is not an uncommon parasite of elk.

Post, G.

- 150 1958 Investigation of insecticides when used to control winter ticks. Wyoming Game & Fish Comm. Job Compl. Rept. Proj. FW-3-R-5, pp. 27-32.
 Several chemicals were tested for control of winter ticks (*Dermacentor albipictus*) on elk on winter feed grounds. Salt containing 5% sulfur appeared to reduce tick numbers on elk. Of 3 organic phosphate compounds tested, one showed some effect.

Post, G. and G. M. Thomas

- 151 1961 A study of anaplasmosis in elk. J. Am. Vet. Med. Assoc. 139: 357-358.
 The results obtained in this study indicate that elk blood, which reacted positively to complement-fixation (CF) tests employing bovine antigen, did not produce anaplasmosis in 2 calves inoculated. The calves proved to be susceptible to the infection as demonstrated by subsequent injection of blood from an anaplasmosis carrier animal. The results obtained with 3 sheep were inconclusive. Reactions to the CF tests were positive after they were given elk blood, for which there was no apparent explanation. Anaplasma bodies were not detected on stained blood slides, and no change in the packed cell volume was observed.

Presidente, P. J. A.

- 152 1968 Infectivity and immunogenic capability of *Dictyocaulus* species from elk and cattle in experimentally infected bovine calves. M. S. Thesis, Montana State Univ. Bozeman, Mont. 41 pp.

Patent infections or clinical symptoms did not develop in 5 Holstein calves inoculated *per os* with 5,000 to 10,000 elk lungworm larvae (*Dictyocaulus viviparus*, wild strain). In a reciprocal cross infection a captive elk calf, inoculated with 24,000 *D. viviparus* larvae (domestic strain), developed a patent infection which lasted for 24 days. A yearling sheep, inoculated with 20,000 *D. viviparus* larvae (wild strain), was refractory to a challenge dose of 50,000 *D. filaria* larvae 7 months later.

Presidente, P. J. A., D. E. Worley and J. E. Catlin

- 153 1972 Cross-transmission experiments with *Dictyocaulus viviparus* isolates from Rocky Mountain elk and cattle. J. Wildl. Dis. 8:57-62.

Reports experimental studies in which the infectivity of *Dictyocaulus viviparus* larvae isolated from elk was tested in bovine calves. Patent infections did not result from these exposures, and animals previously exposed to the elk lungworm strain were partially immune to challenge with homologous strain larvae. A patent infection was established in a captive elk calf after oral inoculation with cattle strain *D. viviparus* larvae.

Price, E. W.

- 154 1956 Liver flukes of cattle and sheep. In U.S. Dept. of Agriculture. Yearbook of Agriculture. Animal Diseases, pp. 148-153. U.S. Govt. Print. Off., Washington, D.C.

Refers to *Fascioloides magna*, the large American fluke, which was first discovered in Italy in 1875 and was thought to have been introduced through importation of *Cervus canadensis* from the United States.

Rabe, C.

- 155 1876/77 Zweifelhafte Infektionskrankheit bei Wapiti-Hirschen (*Cervus canadensis*). Jber, d. Ti. H. Hannover 10:126-130.

Raevskaia, Z. A.

- 156 1929 Zur Kenntnis der Helminthen Fauna des altaischen Marals (*Cervus canadensis asiaticus*). Rabot. 50 Gel'minthol. Eksped. SS.S.T. v Sibiriiu.

Apparently contains description of the intestinal nematode *Nematodirus oiratianus* from *Cervus canadensis asiaticus*.

Raevskaia, Z. A.

- 157 1929a Zwei bisher unbekannte Nematoden (Setarien) von *Rangifer tarandus* und von *Cervus canadensis asiaticus*. Ztschr. Infektionskr. Haustiere 35:40-52.

Raevskaia, Z. A.

- 158 1948 A study of the helminthofauna of the Manchurian wapiti (from data of the 60th UHE). In: K. I. Skrjabin and N. P. Shikhobalova "Filyarii zhivotnykh i cheloveka."

Rastegaeva, E. F.

- 159 1930 Zur Frage über Coccidien wilder Tiere, Arch. Protistenk. 71:377-404.

Eimeria hegneri was found in *Cervus canadensis* from a zoo.

Rice, C. E.

- 160 1947 A survey of elk and buffalo herds for serologic activity with two rickettsial antigens. Can. J. Comp. Med. 11:299-301.

The sera from 185 elk and 36 buffalo killed in 2 national parks in the Province of Alberta were tested by complement fixation tests with Rocky Mountain spotted fever and American Q fever antigens. No significant reactions were obtained.

Rich, G. B.

- 161 1957 The ear tick, *Otobius megnini* (Duges) (Acarina: Argasidae), and its record in British Columbia. Can. J. Comp. Med. 21:415-418.

The ear tick is widespread in the United States in wild and domestic ungulates including elk. It may cause death to the host. Symptoms and life history are outlined.

Rush, W. M.

- 162 1932 Northern Yellowstone elk study. Montana Fish and Game Comm., Helena, Mont. 131 pp.

Records the following parasites and diseases of elk in Yellowstone National Park: necrotic stomatitis; *Sarcocystis miescheriana*; *Dictyocaulus hadweni*; *Cephenomyia* sp.; *Dermacentor albipictus*; keratitis; and Bang's disease or infectious abortion.

Rush, W. M.

- 163 1932 Bang's disease in the Yellowstone National Park buffalo and elk herds. J. Mammal. 13(4):371-372.

Of 35 blood samples examined from elk wintering near Mammoth, two were classed as suspicious and 33 were negative for *Brucella* antibodies. Of 33 samples taken from elk from the Lamar Valley, 3 were positive, 8 suspicious and 21 were negative for *B. abortus* antibodies.

Ryff, J. F.

- 164 1951 Brucellosis absent. Wyoming Wildl. 15:13.

A total of 5 antelope, 18 deer and 12 elk blood samples were tested in Wyoming by the plate agglutination test with *Brucella abortus* antigen. All were negative.

Rykovskii, A. S.

- 165 1959 Information on the helminths of the elk and factors in their development. Trudy Gel'mintol. Lab. 9:253-263.

Parafasciolopsiasis seems to be the most dangerous helminth disease of the wild elk. The seasonal dynamics of helminthic invasion of the elk were studied by means of coprological analyses. Of 23 species of elk helminths, 5 were specifically parasitic for the elk. The prevalence of helminths in domestic animals plays an important role in the development of the helminthofauna of the elk. When elk are maintained in captivity, there is an abrupt change in their way of life and nutrition, which leads to a change in their helminthofauna. Congested maintenance of elk leads to an increase in trichocephalosis. The protection of the wild animals is related to the successful treatment of the domestic animals, thus preventing infection of the wild animals by the domestic ones, to soil improvement and to mollusk control. Dehelminthization of wild elk by adding therapeutic preparations to the feeding places is also recommended.

Sayama, K.

- 166 1952 *Sarcocystis* in deer and elk in California. California Fish & Game 38(1):99-104.

A survey of California big game was made for the presence of *Sarcocystis*. A total of 846 adult deer (*Odocoileus hemionus*), 36 elk (*Cervus nannodes*) and 73 antelope (*Antilocapra americana*) were examined. Sixty-eight percent of the deer, over 50 percent of the elk, and none of the antelope had the parasites. A description of *Sarcocystis*, its tropisms, distribution, age prevalence and pathogenicity is reported.

Schlegel, M. W., T. A. Leege and R. F. Lapen

- 167 1972 Injurious antler anomaly in a Rocky Mountain elk. J. Wild. Dis. 8:319.

A mature bull elk killed by hunters in northern Idaho in 1971 had a lesion in the neck musculature resulting from abnormal growth of an antler tine which had penetrated the skin near the base of the left ear.

Schoening, H. W.

- 168 1956 Rabies. In U.S. Dept. of Agriculture. Yearbook of Agriculture. Animal Diseases, pp. 195-202. U.S. Govt. Print. Off., Washington, D.C.

Elk are reported to be susceptible to rabies, along with a large list of other mammals and several species of birds.

Schwartz, B.

- 169 1928 *Sarcocystis* sp. from the heart of an elk, *Cervus canadensis*. J. Parasitol. 14(3):198.

The heart of an elk from Montana was heavily infected with a large number of cysts of *Sarcocystis* sp.

Schwartz, J. E.

- 170 1942 Range conditions and management of the Roosevelt elk on the Olympic Peninsula. U.S. Dept. of Agriculture, Forest Service. Washington, D.C. 65 pp.

Sarcosporidia (*Sarcocystis* sp.) were found in about 40% of the hearts examined from elk shot by hunters during the open season of 1936, 1937, on the inner lining and throughout the muscle tissue and also in tongue and cheek muscles. The following were also included in this study: *Fascioloides magna*; *Thysanosoma actinioides*; *Oesophagostomum venulosum* (intestinal tract); *Trichurus* sp., *Bovicola americanum*; *Cephenomyia* sp. (only in 2 (?) calves and light infestations); and *Dermacentor albipictus*. *Dictyocaulus viviparus* was in greatest abundance in elk examined during the late winter and spring.

Schwartz, J. E. and G. E. Mitchell

- 171 1945 The Roosevelt elk on the Olympic Peninsula, Washington, J. Wildl. Mgmt. 9(4):295-319.

In three winters and springs, 122 elk were found dead or dying. Malnutrition and mouth lesions were found in some. In 32 autopsies and the following parasites were found: the lungworm, *Dictyocaulus viviparus*; the tick, *Dermacentor albipictus*; lice, *Bovicola americanum*; tapeworms, *Thysanosoma actinioides*; two roundworms, *Oesophagostomum venulosum* and *Trichuris* sp.; *Sarcocystis*; and the bot larva *Cephenomyia* sp.

Shaldibin, L. S.

- 172 1957 Data on the epizootiology of some helminths of elk. Uchenie Zapiski Gorkovski Gosudarstvenni Pedagog. Inst. 19:57-63. (In Russian).

Shaw, J. N.

- 173 1947 Some parasites of Oregon wild life. Oregon Agr. Expt. Sta. Tech. Bull. 11. 16 pp.

Reports the occurrence of the giant liver fluke, *Fascioloides magna*, in the liver of Oregon elk. (No details given.)

Shillinger, J. E.

- 174 1942 Diseases of wildlife and their relationship to domestic livestock. In U.S. Dept. of Agric. Yearbook of Agriculture. Keeping Livestock Healthy, pp. 1217-1225. U.S. Govt. Print. Off., Washington, D.C.

Brucellosis is rather common among big-game ruminants. Brucellosis-free herds of buffalo and elk are being built up by vaccination. Worm parasites (*Dictyocaulus filaria*) have been recorded in elk.

Skinner, M. P.

- 175 1928 The elk situation. J. Mammal. 9(4):309-317.

The author discusses management and condition of the Yellowstone elk on pp. 315-316 and comments on the following diseases which occur in this herd: scabies, hemorrhagic septicemia, ticks.

Skrjabin, K. I. ed.

- 176 1949 Key to parasitic nematodes. Vol. I. Spirurata and Filariata. Academy of Sciences of USSR. Helminthological Laboratory, Moscow/Leningrad. 497 pp.

Contains the following references to helminths in wapiti: *Setaria altaica* in abdominal cavity of *Cervus canadensis asiaticus*; *Wehrdikmansia flexuosa* in hypodermic tissue of *Cervus canadensis xanthopygus*.

Skrjabin, K. I., N. P. Shikhobalova and R. S. Shul'ts

- 177 1954 Essentials of nematodology. Vol. III. Trichostrongylids of animals and man. Academy of Sciences of USSR. Helminthological Institute, Moscow. 680 pp.

Contains the following references to helminths in wapiti: *Nematodirus oiratianus* in Altai wapiti (*Cervus canadensis asiaticus*) in the Mongolian People's Republic; *Nematodirus spathiger* in Altai wapiti; and *Spiculopteragia schulzi* in American elk (*Cervus canadensis*) in USSR.

Skrjabin, K. I., N. P. Shikhobalova, R. S. Shul'ts, T. I. Popova, S. N. Boev, and Delyamure, S. L.

- 178 1953 Strongylata. Academy of Sciences of the USSR. Helminthological Laboratory, Moscow. 890 pp. (English translation available from O. T. S., U.S. Dept. of Commerce, Washington, D.C.).

Dictyocaulus eckerti considered synonymous with *D. hadweni* Chapin, 1925 ex parte, p. 614. Hosts: *Rangifer tarandus*, *Cervus elaphus canadensis*, *C. e. elaphus*, *Alces americana*, *Capreolus capreolus*.

Sprehn, C. E. W.

179 1927 Nematoden in Saugetieren. Ztschr. Saugetierk. 2:38-67.

In *Bison bison*, *Alces americanus* and *Cervus canadensis*.

Stelfox, J. G.

180 1962 Liver, lungs & larvae/parasites and diseases in moose, deer and elk in Alberta. Land-Forest-Wildl. 5(4):5-12.

Abnormalities were observed by hunters in the flesh, liver and lungs of animals shot, and tissue specimens were submitted to the Provincial Veterinary Laboratory. Hydatid cysts (*Echinococcus granulosus*), tapeworm (*Cysticercus krabbei*), bladderworm (*Cysticercus tenuicollis*) and liver flukes (*Fascioloides magna*) were found. Visible abnormalities were 14 times as common in moose as in deer and 6 times as common in moose as in elk. Two species of ticks, *Dermacentor albipictus* and *D. andersoni*, were also found. One emaciated elk had an average of 249 winter tickes per square foot of hide.

Stiles, C. W.

181 1895 The anatomy of the large American fluke (*Fasciola magna*), and a comparison with other species of the genus *Fasciola*, s. st. Containing also a list of the chief epizootics of fascioliasis (*distomatosis*) and a bibliography of *Fasciola hepatica* by Albert Hassall. J. Comp. Med. and Vet. Arch. 16(3):139-147; 16(4):213-222; 16(5):277-282.

Stiles, C. W.

182 1910 The taxonomic value of the microscopic structure of the stigmal plates in the tick genus *Dermacentor*. U.S. Public Health Serv. Hyg. Lab. Bull. (62):1-7.

This is a good monograph of the genus *Dermacentor* for its time. It is well illustrated with colored plates and line drawings. For current nomenclature of the species of *Dermacentor* the reader is referred to Cooley 1938. The wapiti is listed as being a host to (?) *Dermacentor albipictus* (Packard).

Stiles, G. W.

183 1942 Anaplasmosis: a disease of cattle. In U.S. Dept. of Agriculture. Yearbook of Agriculture. Keeping Livestock Healthy, pp. 579-583. U.S. Govt. Print. Off., Washington, D.C.

Anaplasmosis chiefly affects cattle although other animals including elk are reported to be susceptible.

Stuht, J. N.

- 184 1975 Morphology of trypanosomes from white-tailed deer and wapiti in Michigan. J. Wildlife. Dis. 11:256-262.

An unidentified trypanosome was found in the blood of an elk which was immobilized and bled from the jugular vein. Epimastigotes from both deer and elk were morphologically similar to those previously reported in white-tailed deer, but were somewhat larger than forms described from mule deer and elk in New Mexico.

Swales, W. E.

- 185 1935 The life cycle of *Fascioloides magna* (Bassi, 1875), the large liver fluke of ruminants, in Canada, with observations on the bionomics of the larval stages and the intermediate hosts, pathology of fascioloidiasis magna, and control measures. Can. J. Res. 12(2):177-215.

Fascioloides magna reported from the liver of *Cervus canadensis* in Italy, Canada, and the United States.

Swales, W. E.

- 186 1936 Further studies on *Fascioloides magna* (Bassi, 1875) Ward, 1917, as a parasite of ruminants. Can. J. Res. 14(8), Sect. D:83-85.

The tissue reaction of the liver of *Cervus canadensis* to infection with *F. magna* was studied in 2 aged male elk. In general, elk showed little tissue reaction to migrating fluke larvae, whereas domestic sheep were partially resistant to *F. magna*, and cattle were completely resistant and unable to act as definitive host to this parasite. Cervidae were considered normal definitive hosts for *F. magna*.

Sweatman, G. K.

- 187 1957 Life History, non-specificity, and revision of the genus *Chorioptes*, a parasitic mite of herbivores. Can. J. Zool. 35:641-689.

Chorioptes bovis is a parasitic mange mite found on the body of domestic livestock. Although it has never been seen on cervids in nature, Sweatman successfully reared the mites through their life cycle under *in vitro* conditions on epidermal debris and hair taken from 1 of 2 reindeer (*Rangifer tarandus*), 1 of 2 wapiti (*Cervus canadensis*) and 2 of 8 white-tailed deer (*Odocoileus virginianus*). The mites only partially completed their life cycle in the remaining instances as was also the case on epidermal material collected from one mule deer (*O. hemionus*), 2 fallow deer (*Dama dama*) and 2 moose (*Alces alces*). The results suggest that some cervids could be real or potential hosts of this species of mange mite.

Sweatman, G. K.

- 188 1958 On the life history and validity of the species in *Psoroptes*, a genus of mange mites. Can. J. Zool. 36(6):905-929.

A study is presented on the life cycle, morphology and host specificity of the species in the genus *Psoroptes*. Most species of *Psoroptes* occur primarily on domestic livestock, but *P. cervinus* is known only from the western United States from the ears of bighorn (*Ovis canadensis*) and the bodies of wapiti (*Cervus canadensis*). The epizootological history could be of assistance in the identification of body mites from wapiti although there is no evidence that *P. ovis* or *P. equi* cannot survive on this cervid.

Sweatman, G. K. and T. C. Henshall

- 189 1962 The comparative biology and morphology of *Taenia ovis* and *Taenia krabbei*, with observations on the development of *T. ovis* in domestic sheep. Can. J. Zool. 40(7):1287-1311.

Sweatman and Henshall discuss the distribution of the cysticerus of *Taenia krabbei* in North American cervids, basing their account on the literature and on examination of *Alces alces*, *Odocoileus hemionus* and *Cervus canadensis*. They relate the infections to Alaska and Minnesota to the adult stages in *Canis lupus* and elsewhere to infections in *C. latrans*. They suggest that *T. krabbei* is primarily a parasite of *A. alces* and *Rangifer* spp. where these coexist with *C. lupus*. *T. ovis* is restricted to sheep and *T. krabbei* to cervids.

Sweatman, G. K. and R. J. Williams

- 190 1962 Wild animals in New Zealand as hosts of *Echinococcus granulosus* and other taeniid tapeworms. Trans. Roy. Soc. New Zealand. Zoology, 2(26):221-250.

Natural infections with *Taenia hydatigena* were found in wapiti (which were derived from animals transplanted from Wyoming).

Tarczyński, S.

- 191 1954 *Wehrdikmansia cervipedis* (Wehr et Dikmans, 1935) Caballero, 1945, pasożytem jelenia *Cervus elaphus* L. w Polsce. Acta parasit. Polon. 2(7/14):209-222. (English and Russian summaries).

Wehrdikmansia cervipedis was found in subcutaneous nodules of a *Cervus elaphus* in Poland. Of four nodules examined one contained only males and three only females. This is the only report of this nematode in Europe. It has apparently been imported with *C. canadensis* from America.

Thorne, E. T. and J. K. Morton

- 192 1971 The incidence and importance of brucellosis in elk in north-western Wyoming. Wyoming Game and Fish Comm. Job Comp. Rept. Proj. FW-3-R-18, pp. 20-25.

Nineteen and two-tenths percent of 104 Greys River elk and 17.6 percent of 170 *Cervus canadensis nelsoni* from the National Elk Refuge were reactors to two or more of the tests used to detect *Brucella* antibodies.

Thorne, E. T. and J. K. Morton

- 193 1971a Establishing an infective dose of *Brucella abortus* for elk. Wyoming Game and Fish Comm. Job Compl. Rept. Proj. FW-3-R-18, pp. 26-32.

Brucella abortus, type I, strain 2308, was inoculated into two groups, each consisting of two elk, at levels of 7.5×10^5 colony forming units, respectively. The higher dose induced titers which were higher and lasted longer.

Trainer, D. O. and M. M. Jochim

- 194 1969 Serologic evidence of bluetongue disease in wild ruminants of North America. Am. J. Vet. Res. 30:2007-2011.

To determine presence and prevalence of bluetongue in a variety of wild ruminant species in different geographic regions of North America, a serologic study, using the agar gel precipitin test, was initiated. A total of 1,012 serums was examined, and serologic evidence of BT was detected in elk, antelope, bighorn sheep, barbary sheep, moose, and several species of deer. The geographic distribution of BT in wild ruminants generally paralleled that of the disease in livestock, except in Ontario where reactors were detected in moose and deer.

Tunnickliff, E. A. and H. Marsh

- 195 1935 Bang's disease in bison and elk in the Yellowstone National Park and on the National Bison Range. J. Am. Vet. Med. Assoc. 86:745-752.

During 1931-1933, a total of 613 Montana bison were serologically tested for *Brucella abortus* reactors. Approximately 70% of the bulls, 60% of the cows and 44% of the steers produced positive reactions. From 144 elk tested, 8% were reactors, most of which came from ranges used by bison. Isolations of *Brucella abortus* were made from lesions on bison testicles. This disease did not appear to have any ill effect on reproduction of bison in the area studied.

Vaughn, H. W., R. R. Knight and F. W. Frank

- 196 1973 A study of reproduction, disease and physiological blood and serum values in Idaho elk. *J. Wildl. Dis.* 9:296-301.

A study was made of factors which might be responsible for poor reproduction and calf survival rates of elk in The Selway-Bitterroot Wilderness and adjoining primitive area in northern Idaho. Although pregnancy rates were high, only 15-20 calves per 100 cows survived. Antibodies to the following disease agents were not found: brucellosis, leptospirosis, vibriosis, bluetongue, infectious bovine rhinotracheitis, or bovine virus diarrhea. About 50% of the animals had positive complement fixation tests for anaplasmosis but blood from these elk failed to transmit the disease to bovine calves. Blood chemistry values did not indicate nutritional imbalances. Predation was suggested as a possible source of calf losses.

Wallace, F. G.

- 197 1934 Parasites collected from the moose, *Alces americanus*, in northern Minnesota. *J. Am. Vet. Med. Assoc.* 84:770-775.

Dermacentor albipictus and *Dictyocaulus hadweni* were found on *Cervus canadensis*.

Weber, Y. B. and M. L. Bliss

- 198 1972 Blood chemistry of Roosevelt elk (*Cervus canadensis roosevelti*). *Comp. Biochem. Physiol.* 43A: 649-653.

Values were determined for 13 hematologic parameters, including total serum protein, albumin, globulin, blood urea nitrogen, creatinine, uric acid, total bilirubin, glucose, alkaline phosphatase, lactic dehydrogenase, SGOT, cholesterol and packed cell volume. Values for 5 zoo animals and 7 wild elk were compared.

Weber, Y. B. and L. Giacometti

- 199 1972 Sickling phenomenon in the erythrocytes of wapiti (*Cervus canadensis*). *J. Mammal.* 53:917-919.

Sickling was observed in the red cells of two free-ranging elk captured in western Oregon.

Webster, G. A. and T. W. M. Cameron

- 200 1967 Epidemiology and diagnosis of echinococcosis in Canada. *J. Can. Med. Assoc.* 96(10):600-607.

Elk, moose, reindeer and caribou act as the chief intermediate hosts of *Echinococcus granulosus* in Canada, where the life cycle is almost entirely sylvatic. The lungs are the chief site of infection, although occasional infections occur in the long bones, spleen and uterus. Coyotes and wolves are the usual definitive hosts.

Wilson, G. I.

- 201 1969 Some parasites of elk in New Mexico. *Bull. Wildl. Dis. Assoc.* 5:23-24.

Presents parasitological findings on 22 elk taken over a 13-year period from Grant and Rio Arriba counties, New Mexico. Nine were examined for helminths only, and 13 were examined for external and blood parasites as well as helminths. Worms recovered were: *Thysanosoma actinioides*, *Dictyocaulus viviparus*, *Elaeophora schneideri*, *Trichostrongylus axei* and *Ostertagia ostertagi*. One external parasite, *Dermacentor albipictus*, was found.

Winger, R. N.

- 202 1942 A study of the internal parasites of the wapiti, *Cervus canadensis* (Erxleben) 1777. Unpublished report, Dept. of Zool. and Physiol., Univ. Wyoming, Laramie.

Reports occurrence of *Capillaria brevipes*, *Protostrongylus macrotis* and *Thysanosoma actinioides* in elk from the Jackson Hole area and the Medicine Bow National Forest in Wyoming.

Wolfgang, R. W. and J. B. Poole

- 203 1956 Distribution of *Echinococcus* disease in northwestern Canada. *Am. J. Trop. Med. Hyg.* 5(5):869-871.

Elk were recorded with hydatid cysts in northwest Canada.

Worley, D. E.

- 204 1975 Observations on epizootiology and distribution of *Elaeophora schneideri* in Montana ruminants. *J. Wildl. Dis.* 11: 486-488.

No evidence of arterial worm infection was found in 85 elk from Teton and Fremont Counties, Wyoming or in 26 elk from Gallatin County, Montana.

Worley, D. E. and R. E. Barrett

- 205 1964 Studies on the parasites of the northern Yellowstone elk herd. In McBee, R. H. Rumen physiology and parasitology of the northern Yellowstone elk herd. Progress report submitted to the National Park Service, Mammoth, Wyoming, 1964, pp. 10-28.

Twelve species of parasites were recovered from a total of 348 elk collected in the Yellowstone, Gardner and Lamar drainages in Yellowstone National Park between 1962 and 1964, as follows: coccidia (*Eimeria wapiti*); Cestoda (*Moniezia expansa* and *Thysanosoma actinioides*); Nematoda (*Ostertagia* sp., *Nematodirus* sp., *Trichuris* sp., *Capillaria* sp., *Dictyocaulus* sp. and *Protostrongylus* sp.); Arthropoda (*Dermacentor albipictus*, *Psoroptes cervinus*, and *Cephenemyia* sp.). The most prevalent internal parasite was the lungworm, *Dictyocaulus* sp., which occurred in 43.4% of the animals examined. The prevalence of *Dictyocaulus* sp. was higher in the older age classes, and ranged from 34.8% in calves to

61.5% in aged elk (16-21 years). In relation to host sex, 44.1% of females and 26.9% of male elk examined were infected with lungworms. No evidence was found of transplacental infection of the foetus with lungworms in 14 cow elk examined during the last trimester of pregnancy.

Worley, D. E., R. E. Barrett, P. J. A. Presidente, and R. H. Jacobson

206 1969 The Rocky Mountain elk as a reservoir host for parasites of domestic animals in western Montana. Bull. Wildl. Dis. Assoc. 5:348-350.

Nine of 13 genera of helminth or arthropod parasites reported from *Cervus canadensis* in Montana also parasitize cattle, sheep, or horses in this area. *Psoroptes equi* var. *cervinae*, *Cephenemyia* sp., *Protostrongylus* sp. and *Eimeria wapiti* occur only in wild animals. Among the parasites shared by domestic and wild ruminants, *Dictyocaulus* sp., *T. actinioides* and *D. albipictus* are more common in elk than in livestock. Based on these data, it appears that elk do not act as a significant reservoir of livestock parasites in the area studied.

Wright, J. F.

207 1958 Necrotic stomatitis in an American elk. Vet. Med. 53:520-521.

A nine-year-old bull elk in the National Zoological Park developed necrotic stomatitis and was given penicillin and streptomycin with a flying syringe. He improved after 12 days.

Yakimov, V. L. and I. L. Matikashvili

208 1932 La coccidiose du daim. Bull. Soc. Path. Exot. 25(10):1048-1049.

Eimeria spp. (*E. hegneri* and *E. zurnii*) reported from *Cervus canadensis*.

Yamaguti, S.

209 1961 Systema Helminthum. Vol. III, Pt. I. The nematodes of vertebrates. Interscience, New York, p. 458.

Lists occurrence of *Nematodirus oiratianus* in *Cervus canadensis* in Asiatic Russia.

Yeh, L.-S.

210 1959 A revision of the nematode genus *Setaria* Viborg, 1795, its host-parasite relationship, speciation and evolution. J. Helminthol. 33:1-98.

Lists the filarial worm *Artionema altaica* (= *Setaria altaica* Rajevskaya, 1928) from the peritoneal cavity of *Cervus canadensis asiaticus* in the U.S.S.R.

Yorke, W. and P. A. Maplestone

- 211 1926 The nematode parasites of vertebrates. J. & A. Churchill, London, 536 pp.

Dictyocaulus hadweni Chapin, 1925 in *Bison bison*, *Alces americanus* and *Cervus canadensis*. p. 162.

Youatt, B. S. and L. D. Fay

- 212 1961 Survey of brucellosis in Michigan wildlife. J. Am. Vet. Med. Assoc. 139:677.

Four hundred and thirty-five individuals of 23 species of wild birds and mammals were surveyed for antibodies to *Brucella abortus* by the plate agglutination test. No positive results were obtained. The sample included one male elk (*Cervus canadensis*) as the only representative of the Cervidae.

Young, V. A. and W. L. Robinette

- 213 1939 Study of the range habits of elk on the Selway Game Preserve. Idaho Univ. School For. Bull. A9. 47 pp. (Also Idaho Univ. Bull 34(16):1-47.)

Mosquitoes, tabanids and botflies were considered to be the main insect pests of elk in the study area from about June 15 to August 15. Ticks were first observed on elk in late September.

ADDENDUM**Morton, J. K. and E. T. Thorne**

- 214 1975 Long-term effects of brucellosis in elk and the role of venereal transmission. Wyoming Game and Fish Comm. Job Coml. Rept. Proj. FW-3-R-21, pp. 17-21.

Serological titers in captive elk artificially or naturally infected with brucellosis in 1972 remained high for 28 months or more following exposure. Reproductive products were the probable source of exposure for four elk that became infected in June and July. Loss of the first calf following infection was the most apparent clinical sign in cow elk. Most infected cows successfully raised calves in succeeding years.

Thorne, E. T.

- 215 1972 The incidence and importance of brucellosis in elk in northwestern Wyoming. Wyo. Game and Fish Comm. Job Compl. Rept. Proj. FW-3-R-19. 8 pp. 10-22.

The standard plate agglutination test, *Brucella* buffered antigen (BBA) rapid card test, rivanol test, and complement fixation (CF) test were used to detect *Brucella* antibodies in

plasma and serum of 91 elk from the National Elk Refuge. The efficacy of the four tests was compared on 27 samples that reacted to two or more tests.

Thorne, E. T.

- 216 1973 The incidence and importance of brucellosis in elk in northwestern Wyoming. Wyo. Game and Fish Comm. Job Comp. Rept. Proj. FW-3-R-20, pp. 8-16.

Four serological tests were used to detect *Brucella* antibodies in serum of 101 elk from the Greys River Feedground and 94 from the National Elk Refuge. 36 percent and 32 percent, respectively from Greys River and the Refuge reacted to two or more of the tests.

Thorne, E. T. and J. K. Morton

- 217 1972 Short-term effects of brucellosis in cow elk. Wyoming Game and Fish Comm. Job Comp. Rept. Proj. FW-3-R-19, pp. 23-28.

Abortions occurred after young pregnant elk were inoculated with *Brucella abortus*, type 1, strain 2308.

Thorne, E. T. and J. K. Morton

- 218 1973 Long-term effects of brucellosis in elk and the role of venereal transmission. Wyo. Game & Fish Comm. Job Comp. Rept. Proj. FW-3-R-20, pp. 17-21.

Titers of infected calves born in 1972 remained high for 10 to 16 months. One elk became infected in June following exposure to a *Brucella*-positive aborted fetus.

Thorne, E. T. and J. K. Morton

- 219 1975 The incidence and importance of brucellosis in elk in northwestern Wyoming. Wyo. Game and Fish Comm. Job Comp. Rept. Proj. FW-3-R-21, pp. 12-16.

Brucella antibodies were detected in 52 percent of the elk tested at the National Elk Refuge during 1974-75. *Brucella abortus* was recovered from an aborted elk fetus found on the Elk Refuge and from a dead calf found at Greys River.

Thorne, E. T. and J. K. Morton

- 220 1975a Brucellosis transmission between elk and domestic cattle. Wyoming Game and Fish Comm. Job Comp. Rept. Proj. FW-3-R-21, pp. 22-23.

Transmission of brucellosis from elk to domestic cattle occurred in a closely confined group of animals following the birth of a dead elk calf to an infected cow. Horses wintering with feedground elk should be serologically tested for brucellosis.

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¹Epizootic hemorrhagic disease

²Infectious Bovine Rhinotracheitis

³Bovine Virus Diarrhea

